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MODERN PHOTOGRAPHIC DEVELOPERS

A Practical Handbook to the New Developers; Telling What They Are and How to Use Them; With Reliable Formulæ

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Modern Photographic Developers

The disappearance of so many of the photographic developers with whose names and characteristics we have long been familiar, and the appearance of so many "new" developers of unknown origin and composition, under strange and uncouth names, naturally brings forward the questions: What are these new developers made of? Where do they come from? How do they compare in capacity and use with the developers they replace? and the like. These questions have burdened my correspondence for many months past, and some of them have been difficult to answer in a letter of reasonable length. Facing this situation, I determined to devote a whole number of THE PHOTO-MINIATURE to the subject, hoping thus to provide, as Maimonides did so long ago, a "Guide to the Perplexed" and, at the same time, ease my own troubles. Thereupon I first sought the aid of a chemist with experience in this special branch of chemistry, and second, I set out upon an investigation of the American developer industry for whatever that adventure might bring forth. The result will be found in the monograph following, which gathers together all the information at present gettable about modern photographic developers. Mr. Wein, well equipped for his task, has marshaled the available facts concerning his subjects in an interesting way,

and presents them in the simplest and clearest form possible where so many delicate chemical and technical processes are involved. Further, be it noted, I have exercised my editorial privilege liberally, taking prodigious liberties with Mr. Wein's monograph where this seemed necessary or desirable in the reader's interest.

If it should seem to the reader that there is not, after all, much that is new about the "new" developers, let the gentle reader comfort and content himself with the assurance, here frankly given, that his surmise is correct. That much, with some other pertinent facts, I discovered in the personal investigation to which I have referred. At first I was puzzled by the evident reluctance of the makers of the "new" developers to give any definite, commonsense information about the actual composition of their products. It seemed to be impossible to get behind the fanciful trade names and ascertain the chemical composition of the products offered as subsitute developers. This strange abuse of the art of *camouflage* is, I am glad to say, being abandoned, and the "new" developers are being sold under their true and rightful names. As one result of this, it is now seen that our American and British chemists are not inventing or evolving new chemical compounds to replace those so long imported from Germany, but are simply doing their best to reproduce them commercially —a new sort of Declaration of Independence.

—EDITOR.

A Developer Defined

What do we mean when we speak of a photographic developer? In general usage the term indicates the chemical solution used to bring out—"develop" or make visible—the latent but invisible picture image which we know results from the action of light on a dry plate, film, or development or bromide paper, exposed behind the lens in a camera, or behind a negative in a printing frame or enlarger. In these pages, however, the word developer primarily means the active chemical compound, or developing agent proper, which forms the base of the developing solution, and which gives it its developing power or capacity.

Developing Power: Reduction

The light sensitive film with which our plates, films, and printing papers are coated consists of gelatine emulsion in which silver haloids, e. g. silver bromide or chloride, in an extremely fine state of division, are very evenly distributed. We do not know the precise nature of the change or alteration effected by the action of light in this sensitive film during exposure. But we do know that certain chemical compounds, which are easily oxidized, have a preferential action on the silver haloids, reducing to metallic silver those on which light has acted and having little or no action on those not so acted upon by light. This we call developing power since it makes the form and details of the picture image visible to the eye. Thus, by development, which is here seen to be a process of chemical reduction, we get, in the case of a dry plate or film exposed in the camera, a negative picture image on glass or transparent film; and, in the case of printing papers exposed behind a negative, a positive picture image on paper. In this process the developer is the active reducing agent, the other ingredients of the developing solution doing other and different work.

Where the Developers Come From

Most of the compounds which have been found to possess this preferential action as to silver haloids, or power to reduce silver bromide or chloride to metallic silver, are derivatives or substitution products of benzene or naphthalene. As these are known as "organic compounds," so the developers obtained from them are called organic developers, and the chemistry of development is an interesting branch of organic chemistry. Without venturing too far into this world of wonders, we can get a fairly clear notion of the origin and source of our modern developers by a little study of benzene and some of its derivatives, which we will now proceed to do.

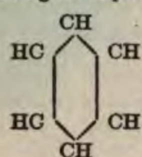
Benzene

Benzene, the venerable parent of almost all the developers used in photoggraphy during the last fifty years, and of great importance in the making of dye stuffs and pharmaceutical preparations, was discovered by Faraday in 1825, and is commercially manufactured

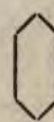
from coal-tar distillate. To the chemist it is known as C_6H_6, which simply expresses the fact that the benzene molecule consists of six groups of atoms, each of these groups containing one atom of carbon (C) and one atom of hydrogen (H).

Kekule's Hexagon

In 1866, Kekulé published the fact that benzene behaves in its reactions with other bodies as though the carbon atoms were linked together round the points or angles of a hexagon, each with a hydrogen atom attached to it. This gives us the famous Kekulé hexagon formula for benzene, sometimes called the benzene ring. For clearness in what follows, we will show this graphically: (1) In full; (2) as generally abbreviated in use, the C and H atoms being supposed to be at each angle, except where the substitution of other atoms or groups is shown by the introduction of a new symbol; and (3) with the points numbered to show in which position any addition or substitution is made, this being of importance, as we shall see later.



(1)



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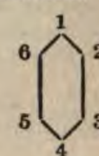
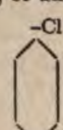


(3)

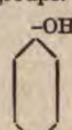
Derivatives: Phenol: Aniline

Thus far the simple but fascinating benzene molecule. Now let us see how the derivatives or substitution products are obtained. The hydrogen (H) atoms in benzene are easily replaceable by other atoms or chemical groups as, for instance, chlorine (Cl), hydroxyl (OH), or amido (NH_2) groups. Thus we get:



Chlor-benzene

(4)



Hydroxy-benzene or Phenol (Carbolic Acid)

(5)

Amido-benzene or Aniline

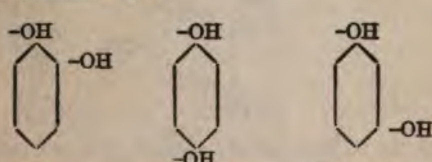
(6)

Significance of Group Relations

None of these compounds has any developing power. If, however, we replace the two hydrogen atoms in two of the CH groups by two hydroxyl (OH) groups, or by two amido (NH_2) groups, or by one hydroxyl and one amido group, we may or may not get compounds (derivatives or substitution products) possessing developing power. Whether we do or not depends upon the position of the second substituted hydroxyl or amido group in relation to the first. See Fig. 3 at this point. When the replacement or substitution (or introduction of atoms or groups) takes place in adjacent CH groups, we get what is known as an *ortho* compound or derivative. If the replacement takes place at opposite corners we get what is known as a *para* derivative. But if the replacement takes place at neither adjacent nor opposite points, but always with one CH group between, the result is known as a *meta* compound. The significance of the relations between the substituted groups in these changes lies in the fact that the *ortho* and *para* compounds have developing power and so give us developers, while the *meta* compounds lack this power.

Catechol Quinol Resorcin

For example, if we take the benzene molecule (Fig. 1) and replace the two hydrogen (H) atoms at 1 and 2, at 1 and 4, and at 1 and 3 (Fig. 3) by hydroxyl (OH), we get three *bi*-substitution hydroxy-benzene derivatives thus:



(7) Ortho- (8) Para- (9) Meta-

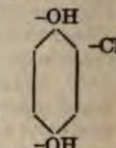
hydroxy-benzene

Of these (7) is catechol, which we know as the energetic developer pyrocatechin; (8) is quinol, or hydroquinone; and (9) is resorcin which has little or no developing

power. They all have the same chemical formula $C_6H_4\ (OH)_2$, i. e. the same chemical composition, but differ in *constitution*, and their usefulness as developers is seen to depend on the position of the substitution groups. It may be added that the *para* compounds are usually more powerful or more energetic as developers than the *ortho* compounds.

Adurol

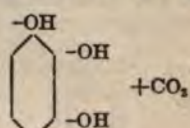
Pursuing the substitution idea further, Hauff replaced the hydrogen atom (H) in the second position (Fig. 3) in hydroquinone (Fig. 8) by chlorine (Cl), thus: with the formula $C_6H_3Cl\ (OH)_2$, a halogen substitution product, mono-chlor-hydroquinone to which he gave the name Adurol-Hauff. Schering introduced or substituted bromine in the same way, obtaining mono-bromo-hydroquinone with the formula $C_6H_3Br(OH)_2$, these modifications being said to give adurol definite advantages as compared with hydroquinone as a developer, the mono-chlor compound being preferable to the mono-brom product.



(10) Adurol

Di- and Tri-oxy-Phenols

Pyrocatechin, hydroquinone and adurol are grouped together as bi-oxy-benzenes. Pyro, which has been used as a developer since 1851, is a tri-oxy-benzene, the hydrogen (H) atoms in positions 1:2:3 (Fig. 3) being replaced by three hydroxyl groups thus:



(11) Pyro

which shows how closely related it is to hydroquinone and pyrocatechin.

Amido and Other Groups

What has been said of the substitution or introduction of two hydroxyl (OH) groups in obtaining di-hydroxy-benzene derivatives, holds good in the use of two amido (NH_2) groups, which gives us a similar series of ortho, para,

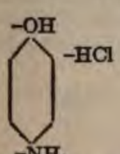
and meta di-amido benzenes (diamidophenols). Similarly, we may substitute one hydroxyl and one amido group, this giving amido-hydroxy-benzenes (or amidophenols), and these substitutions may be further extended. Thus, in the amido (NH_2) group one of the hydrogen (H) atoms may be replaced by a methyl group, viz. CH_3.

Para-amido-phenol Diamidophenol

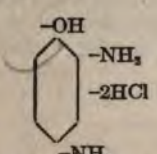
For example, if we take phenol (Fig. 5) and introduce an amido (NH_2) group in place of a hydroxyl (OH) group, we get para-amido-phenol (Fig. 12) which is the base of most of our "new" American developers, and was formerly sold in concentrated form as Rodinal, Unal, Citol, etc. The introduction of a second amido (NH_2) group gives us diamidophenol (amidol) as shown in Fig. 13.

Metol, Glycin, Ortol

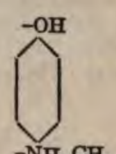
Metol is obtained by the introduction of a methyl (CH_3) group as in Fig. 14 and is a *para* derivative of amidophenol, according to Andresen and Hauff, although Schweitzer, a few years ago, speaking apparently from information obtained from its originators, states it to be the sulphuric acid salt of monomethyl-paramido-metacresol, which is, so to speak, "a horse of another color." As matter of fact, its chemical constitution has never been divulged.



(12) Paramidophenol



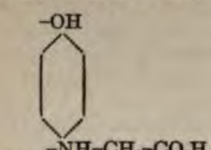
(13) Diamidophenol or Amidol



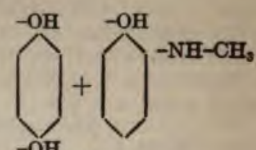
(14) Metol (base)

Glycin, essentially, is metol with the methyl radicle replaced by acetyl (CH_2COOH), this giving para-oxy-phenyl-acetic acid, with the formula C_6H_4 OH. $NHCH_2$ CO_2H shown in Fig. 15. Ortol is said to be a compound of one molecule of hydroquinone and two molecules of methyl-*ortho*-amidophenol sulphate (similar

to the para form—metol), being a patented mixture, probably as seen in Fig. 16



(15) Glycin

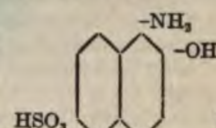


(16) Ortol

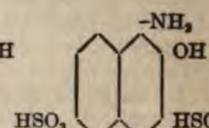
Naphthalene Group: Eikonogen Diogen, etc.

It is characteristic of the benzene groups that they readily link themselves together, giving compounds of great complexity from which other derivatives useful as developers may be obtained. Thus, by linking two benzene rings, as seen in Fig. 17, we get naphthol ($C_{10}H_8$) from which eikonogen (Fig. 18) and diogen (Fig. 19) are derived.

(17) Naphthol

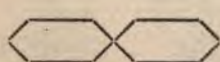


(18) Eikonogen

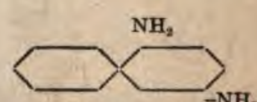


(19) Diogen

Or we may imagine the two rings linked as in Fig. 20, representing the compound diphenyl ($C_{12}H_{10}$), from which the Agfa developer Diphenal is obtained, as seen in Fig. 21.



(20) Diphenyl



(21) Diphenal

What We Have Learned

This graphic survey of the substitution possibilities of the benzene compound may well suffice to give us a practical notion of the origin of some of our modern developers. As we know, most of them were patented products imported from Germany, and, as our chemists

are finding out, generally differed in actual composition or constitution from what was set forth concerning them in formulas and patent specifications. In the attempts made by American and British chemists to reproduce them, one may sum up present results by saying that the British product Metol-Johnsons and the American Methylol very closely approach German Metol in chemical composition and the results they give. Paramidophenol, in many forms and all manner of disguises, and hydroquinone of excellent quality are being regularly manufactured here and in England. Azol is the name of a British-made Rodinal, said to be identical with the German product. And we are assured of American- and British-made amidol (diamidophenol) fully equal to the French and German makes so long used on both sides of the Atlantic. With which we may now turn our attention to the developers in detail.

Pyro

Of pyro I propose to say little or nothing here. It has its place among modern developers only because it is still the most widely used and the most useful of all photographic developers. Properly known and intelligently handled, it will do all that any other developer will do, excepting only the development of bromide and gaslight papers, wherein the more modern, stainless developers, such as amidol are preferable. But to explain the advantages of pyro would fill a book bigger than this. Some day we may devote a whole issue of THE PHOTO-MINIATURE to it and so do it justice.

Characteristics

Chemically, pyro—otherwise pyrogallol or pyrogallic acid—is $C_6H_3(OH_3)$, a tri-oxy-benzene, as seen in Fig. 11, page 422. It comes in fine, white, feathery crystals, bulky and difficult to handle (resublimed), and in heavy crystals, which form is altogether preferable. It is readily soluble in cold water, and concentrated solutions can be prepared with sodium sulphite. It is extremely sensitive to potassium bromide, which should be used sparingly. It oxidizes very quickly in use or exposed to the air; but combined with an acid gives a clear solution, which will remain colorless for months if kept in well-filled, stoppered bottles.

In Use

Photographically, pyro is the most ancient of developers, dating away back to 1851 in Scott Archer's wet-plate process, and to Major Russell (1862) as an alkaline developer. It is also the most modern because it is used today by the majority of professional workers all the world over, and it is the best developer for tank development of films, in combination with metol or other of the detail-giving compounds. It surpasses all other developers in flexibility and the control it offers over the printing quality (density and color) of the negative. Unless used with more than average care and caution it stains the hands abominably. It combines well with metol, glycin and rodinal or their other-named equivalents. A pyro developer can be used but once, after which it must be discarded; in spite of which pyro is the most economical of all developers. I do not give any formulas for the use of pyro, alone or in combination. Their name is legion. You will find them in every box of plates and package of films, and they vary according to the use and the character of the plate or film with which they are to be used.

Hydroquinone

With the single exception of pyro, to which it is closely allied, hydroquinone, otherwise named hydrochinone or quinol, is probably the most largely used of modern developers. It was introduced by Abney in 1880, and is a di-oxy derivative of benzene, two hydroxyl groups (OH_2) being substituted for the hydrogen atoms in the *para* position in the benzene ring, as shown in the margin. To the chemist it is para-dioxy-benzene, $C_6H_4\ (OH)_2$. Its purity and quality are indicated by its color; when chemically pure it comes in snow-white, fine, needle-like formation. It is sparingly soluble in cold water (5 per cent), but freely soluble in warm water or alcohol.

Commercially, hydroquinone is prepared by oxidizing aniline with potassium or sodium bichromate and sulphuric acid, which gives a yellow, crystalline precipitate (quinone). This is dissolved in water and a stream of sulphur dioxide is passed through the solution

until it smells of sulphurous acid. The suspended matter in the solution is now filtered off, and the hydroquinone extracted from the filtrate by means of ether, which is subsequently distilled off, leaving the hydroquinone in its characteristic form. Until recently almost all the hydroquinone used in America and Britain was manufactured in Germany, but it is now produced by several firms in America equal to the highest European pre-war standards, e. g. Gennert's Gold Label hydroquinone.

Characteristic Capacity In today's practice hydroquinone is generally employed in combination with other developers, being seldom used alone, e. g. as pyro is commonly used, except in copying and lantern-slide work, wherein its characteristic capacity for giving great density, with clear shadows and brilliancy of gradation is of obvious advantage.

Comparisons Compared with pyro, hydroquinone keeps better in solution, does not stain the fingers in use, and gives negatives of a blue-black color similar to that obtained with ferrous oxalate. In comparison with metol and rodinal, it is a slow-acting, "hard" working developer, yielding "snappy" negatives with strong contrasts.

Influence of Temperature Hydroquinone has the disadvantage of being very susceptible to variations of temperature. At a low temperature it is apt to crystallize out in its solutions, which either brings development to a standstill or slows down its action; in any event cold hydroquinone developing solutions mean loss of detail and density in the negative. Advantage may be taken of this by the use of cooled solutions for the development of negatives known to be grossly over-exposed. Normally it is advised to keep a hydroquinone developing solution at a temperature of 65° Fahr. In cold weather this may be raised to 70°. Increase in temperature, however, tends to excessive density and fog, this tendency varying according to the character of the plate in use.

How Used Used alone, hydroquinone is generally made up with potassium or sodium carbonate, and these carbonate alkalies are advised, although the use of a caustic alkali gives

greater rapidity and softer contrasts. Sodium sulphite has a marked influence in hydroquinone development; the greater the proportion of sulphite employed in a given formula, the stronger will be the contrasts in the negative. Potassium bromide acts as a powerful restrainer with hydroquinone, and is therefore sparingly used, e. g. 3 to 5 drops of a 10 per cent solution in 4 ounces of developer for normal exposures; 10 to 30 drops in cases of overexposure or with soft working plates. Citric acid and yellow prussiate of potash are alternate restrainers.

Single-Solution Formula

A satisfactory single-solution hydroquinone developer may be made up as follows: Water (hot), 15 ounces; hydroquinone, ½ounce; sodium sulphite (cryst.), 4 ounces; potassium carbonate, 6 ounces; potassium bromide, 18 grains. Dilute with from 4 to 6 times its bulk of water for normal use.

Two-Solution Formula

Cramer's two-solution developer is as follows: No. 1—Distilled water (hot), 25 ounces; sodium sulphite (cryst.) 3 ounces; hydroquinone (Hauff), ½ounce; potassium bromide, ¼ounce. No. 2—Water, 25 ounces; sodium carbonate (cryst.), 6 ounces. For use, take equal parts of No. 1 and No. 2 at 65° Fahr.

For Lantern Slides

A typical two-solution formula for lantern slide plates is as follows: No. 1—Water (hot), 20 ounces; hydroquinone, 150 grains; potass. metabisulphite, 10 grains; potass. bromide, 50 grains. No. 2—Water, 20 ounces; sodium sulphite (cryst.), 2 ounces; sodium hydrate, 100 grains. For use take equal parts No. 1 and No. 2.

In Copying

For copies of line drawings, sketches, maps, etc., where extreme density combined with clear lines is required, the following formula will be found reliable: No. 1—Water (hot), 20 ounces; hydroquinone, 160 grains; sodium sulphite (cryst.), 4 ounces; citric acid, 60 grains; potass. bromide, 160 grains. No. 2—Water, 20 ounces; potass. hydrate, 320 grains. For use take equal parts of No. 1 and No. 2, or, where overexposure is indicated, 2 parts No. 1 to 1 part No. 2.

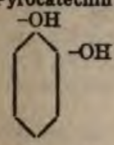
When Stains Come

Although commonly described as a stainless developer, an oxidized or stale hydroquinone solution will produce yellow stains, as in the prolonged forcing of an underexposed negative in development (wherein hydroquinone should not be used.). This stain rarely yields to ordinary "clearing" agents, but may be removed by the skilful use of Farmer's Reducer, the process of stain-removal being carefully watched so that the density of the negative is not affected.

Combined with Other Developers

Thus far we have considered the use of hydroquinone alone as a developer, in which use its characteristics are most clearly exhibited. By far its largest use, however, is in combination with other developers, such as metol, paramidophenol, edinol, rodinal, etc. Its action in all these combinations seems to be to add vigor and density-giving power. Formulas for such combinations are given in the consideration of the respective developers mentioned.

Pyrocatechin



Identical in chemical composition with hydroquinone, but differing from it in constitution, in that the two dioxy groups $(OH)_2$ are substituted for the hydrogen atoms in the *ortho* position in the benzene ring, we have pyrocatechin or catechol. This is known to chemists as ortho-dioxy-benzene, $C_6H_4\ (OH)_2$ and comes in prismatic colorless crystals, freely soluble in water and alcohol.

History: Variations

The use of alkaline solutions of pyrocatechin for development was observed by Eder and Toth in 1880, but it comes within our survey of modern developers because of its re-introduction in 1898, in modified forms, known as Elconal, Elconal F and Kachin. These seem to have disappeared from the market, but pyrocatechin is still listed by a few chemists.

Compared with Hydroquinone

In action pyrocatechin is said to be more energetic than hydroquinone, but otherwise very similar except that it is not so markedly influenced by ordinary variations of

temperature and has no tendency to fog. It is made up with either carbonate or caustic alkalies.

A Formula

A reliable formula is as follows: No. 1—Water, 10 ounces; pyrocatechin, 80 grains. No. 2—Water, 10 ounces; tribasic sodium phosphate, 1 ounce; sodium sulphite (cryst.), 3 drams. For normal exposures take one part each of No. 1 and No. 2 and add one part water. (For a more vigorous, quick-working developer for normal exposures, increase the sodium salt in No. 2 by from 50 to 100 per cent.) For slight overexposure, take 2 parts No. 1, 1 part No. 2; for marked overexposure add to the above one-tenth part of 10 per cent potass. bromide solution. For underexposure, take 1 part No. 1, 2 parts No. 2 and add 3 parts of water, following, if necessary, by more of No. 1 to gain density. The restraining power of potass. bromide is small when carbonate alkalies are used, but increases when caustic alkalies or the tribasic sodium salt is employed.

Elconal F: Kachin

Pyrocatechin is the only developer which retains its normal developing power in the presence of "hypo," hence, in its modified forms of Elconal F and Kachin it was exploited for simultaneous development and fixing, but general experience failed to support the claims made for it in this particular.

The most extravagant claims were made in behalf of Kachin as a developer when it was introduced in Britain, many experimentors averring that it possessed all the virtues and none of the defects of other developers, but it seems to have vanished so far from human ken that it is no longer "formularized" in the "B. J. Almanac," wherein it held place from 1899 to 1916.

Metoquinone Quinomet

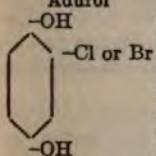
A chemical combination of metol (base) and hydroquinone (C_6H_4 OHNH) $(CH_3)_2 + C_6H_4$ $(OH)_2$, introduced by Lumière in 1903 as an energetic developer used with or without an alkali. Sold in Britain as Quinomet. It is a fine, white powder, sparingly soluble in cold water, but freely soluble in hot water. A typical formula for time exposures is: Water (hot), 20 ounces; metoquinone, 86 grains; sodium sulphite (cryst.), 2½ ounces.

Dissolve the ingredients in the order named. For the development of instantaneous exposures, add acetone, 1¼ ounces, or one-third this quantity of sodium tribasic phosphate, or one-sixth the quantity of caustic lithia. This is Lumière's formula.

Pyramidol

This, a condensation product of hydroquinone and paramidophenol, introduced by Hauberrisser a few years ago, is not now in the market. It had the formula $C_6H_4OHNH—C_6H_4\ (OH_2)\ H_2SO_4$. In use it resembled paramidophenol, but offered special advantages for the correction of gross overexposure by its behavior with potassium bromide, yielding good negatives in overexposure ranging from sixteen to forty times normal.

Adurol



In the brief survey of the origins of our modern developers already made, the reader has observed the changes or modifications in developing properties effected by the introduction or substitution of such groups as OH and NH_2 in various developer nuclei. The formation of para-dioxy-benzene or hydroquinone, seen in Fig. 8, page 421, is an illustration of such a change. In 1898 Hauff and Lüppe Cramer independently investigated the possibilities of modifying hydroquinone by substituting a halogen (chlorine, bromine, etc.) for one of the hydrogen atoms in the hydroquinone nucleus. Their investigation resulted in the commercial introduction (1899) of two halogen derivatives of hydroquinone, both of which we know as the developer Adurol. As made by Hauff, Adurol is monochlor-hydroquinone, $C_6H_3(OH)_2Cl$; as made by Schering it is monobrom-hydroquinone, $C_6H_3(OH)_2Br$. They are identical in general characteristics and behavior, although Lumière and Seyewetz, in a later investigation (1914), found that the monobrom product was more energetic than the monochlor form.

How Made

Commercially Adurol is made by passing bromine or chlorine into a solution of hydroquinone in benzene and evaporating to crystallization. It comes as a white, crystalline powder, readily soluble in water.

Compared with Hydroquinone

The practical purpose of Hauff's and Cramer's investigation was, of course, to improve hydroquinone by the elimination of its well-known disadvantages. This they accomplished. In its developing power Adurol stands between hydroquinone and metol, and it is equally useful for negative, lantern slide and print development. It has better keeping quality in solution than hydroquinone, and is hardly influenced at all by changes in temperature. It gives greater density than hydroquinone, even without caustic alkalies, and is less inclined to harsh contrasts or hardness. Its solutions do not discolor, hence the Adurol developer is stainless as to plates, films, papers, and fingers. In development, as compared with hydroquinone, Adurol is more energetic in action, yields softer negatives, and can be used repeatedly. It gives a blue-black image and is therefore very suitable for the development of development and bromide papers.

Lack of Appreciation

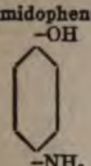
With all these improvements over hydroquinone, verified by authority and experience, it is not easy to understand why Adurol has not long ago displaced hydroquinone in photographic practice. The fact remains that it has not interfered, to any degree worth mentioning, with the steadily increasing popularity and use of hydroquinone and metol.

Formulas

Typical formulas are given as follows: For plates and films, Two-Solution Developer: No. 1—Water, 10 ounces; sodium sulphite (cryst.), 1¾ ounces; Adurol, 85 grains. No. 2—Water, 10 ounces; potassium carbonate (cryst.), 1¾ or 2 ounces. For normal outdoor exposures take equal parts Nos. 1 and 2; for known overexposure take 1 part each Nos. 1 and 2 and 1 part water; for portraiture take 3 parts No. 1 and 2 parts No. 2. As a concentrated single solution developer, the following is advised: Water, 10 ounces; sodium sulphite (cryst.), 4 ounces; potassium carbonate, 3 ounces. Dissolve thoroughly by heat, allow to cool, and add Adurol, ½ ounce. For portraits or subjects with detail, take 1 part of this to 3 parts of water. Adurol is very sensi-

tive to the restraining power of potassium bromide, the use of which slows development and tends to excessive density. Nevertheless, a 10 per cent solution of potass. bromide is to be used when fog is feared, rarely more than 2 drops per ounce of developing solution.

Paramidophenol



Of all the photographic developers introduced during the past thirty years, paramidophenol may fairly be said to be at once the most important and the most widely used, although comparatively little known under its own name. It was first used, photographically, by Andresen in 1888, and has been commercially exploited by world-wide advertising, in many forms under different trade names, since 1891.

Chemical Composition

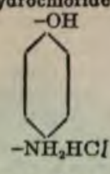
As its formula $C_6H_4OHNH_2$ shows, paramidophenol differs in chemical composition from hydroquinone only in the fact that one of the OH groups is replaced by an NH_2 group. Compare the figures 8 and 12 on pages 421 and 423. This difference, the conjunction of an hydroxyl group and an amido group in the para relation, results in a compound which, in its various salts and combinations, possesses remarkable developing properties. As we will see, paramidophenol is the foundation of many of the patented developers with fancy names, which formerly came to us from Germany, as well as of most of the "new" developers with even more fanciful names, now being manufactured in America and Britain.

Commerical Preparation

Commercially, paramidophenol is a phenol compound, prepared by adding nitric acid to phenol, when an oil separates, which is a compound of ortho- and para-nitrophenol. This is subjected to steam, when the volatile ortho-nitrophenol (used in making the developer sold as Ortol) distills over, leaving the non-volatile para-nitrophenol as a residue, which is reduced to paramidophenol by treatment with hydrogen. In this form, paramidophenol (free base), with sodium sulphite alone, has some developing power, but is so sparingly soluble in water as to be of little practical use as a developer. It has, however, distinctive properties

(e. g. it can act in a weak way, both as a base and an acid), which make it extremely useful as a base for the preparation of other compounds, salts, etc., more freely soluble and more powerful as developers.

Paramido-phenol-hydrochloride



As a base paramidophenol readily combines with strong acids, such as hydrochloric and sulphuric acids. With the first it forms paramidophenol-hydrochloride, $C_6H_4OHNH_2HCl$. This is the salt most generally obtainable commercially, and that usually intended in formulas where "paramidophenol" is mentioned without further specification. It comes in fine, prism-like crystals, more or less white, according to the purity of the product. A good sample should contain 75 per cent or more of paramidophenol. The hydrochloride salt is said to possess 20 per cent more developing power than the sulphate, and is sold under its own name, as well as under various trade names, as Kodelon, etc.

Test for Purity

Generally speaking, the purity and quality of a sample of paramidophenol-hydrochloride is assured, if purchased from a responsible maker or dealer. The following test, for which I am indebted to Mr. L. H. Wallace, is simple and efficient for its purpose. Add 10 grains paramidophenol-hydrochloride to 1 ounce distilled water in a clean glass vessel. If the sample is pure, it will dissolve readily and give a clear, colorless solution which will remain clear for several hours. If when first prepared the solution shows a purplish, yellowish, or greenish color, this denotes the presence of dye-stuff; if particles of insoluble matter remain in suspension in the solution, this indicates the presence of organic impurities; both are detrimental to the keeping and developing power of the sample, in proportion to the showing on test.

Solubility-Keeping Qualities

Paramidophenol-hydrochloride is readily soluble in water (1:10) but keeps better in fairly strong solutions than in diluted solutions. Dissolved in 5 or 10 per cent sodium sulphite solution it will keep clear and

retain its characteristic qualities for days. When made up in developing solutions where the sodium carbonate predominates, pure paramidophenol-hydrochloride has excellent keeping quality. If the salt is impure, however, it will be necessary to have the sodium sulphite in excess, which, however, is detrimental to the developing power of the solution.

Notable Peculiarities

As paramidophenol developers are generally compared (as to their practical efficiency) with the familiar (German-made) metol developer, it is important to note here two peculiarities of paramidophenol which materially influence any comparison of the two developers in use.

"Slowing up" "Speeding up"

First: When paramidophenol is dissolved in sodium sulphite, or sulphite and potassium or sodium carbonate solutions, there results a formation of the true paramidophenol base in the solution. This robs the solution of its developing power in some degree, so that such developers are said to "slow up" or "run down" more quickly than metol developers. It is not so in fact, as the apparently exhausted developing solution can be speeded up by the addition of small quantities of sodium hydrate (caustic soda). This redissolves the paramidophenol base first precipitated and makes it effective again for development. A saturated solution of sodium hydrate can be kept on hand and conveniently used for this purpose as needed, just as we use a 10 per cent solution of potassium bromide for restraining development. With this addition of caustic soda as needed, it will be found that paramidophenol (hydrochloride or sulphate salt) approximates metol in developing power and efficiency.

Sensitive to Potass. Brom.

Second: It is often advised to use paramidophenol "the same as metol," i.e. replacing the amount of metol called for in any formula by an equal amount of paramidophenol salt. This is radically wrong. Where the makers give a definite formula, follow the formula as to the amount of paramidophenol required. Further, paramidophenol, unlike metol, is extremely sensitive to the restraining and retarding action of potassium bromide,

and this should, therefore, be used with intelligent caution in connection with paramidophenol developers. In many formulas using metol, the amount of potassium bromide equals the amount of metol. With paramidophenol the proportion should rarely exceed 1 part of potassium bromide to 10 parts of paramidophenol. Generally a less quantity of bromide can be used to advantage. Always, if the paramidophenol is pure, the proportions given will be sufficient to clear the whites.

As to Sodas It should also be noted that to secure the largest efficiency of results with paramidophenol salts, the quality and uniformity of the sodas used is important. There is so much confusion here in commercial brands that the only right way is to use those specifically mentioned in the formula employed, or to select a reliable brand and use that brand uniformly and exclusively.

Getting Density Finally, we come to the complaint that many fail to get sufficient density with paramidophenol to give good printing negatives. This is generally due to the fact that, with paramidophenol, as with metol and amidol, the image appears rapidly but gains density slowly. Also a little density is lost in fixing. The remedy is obvious. Carry development a little further than seems necessary by the usual visual test, in order to make sure of a negative of sufficient density to yield good gradations in your prints.

Formulas When paramidophenol-hydrochloride was first introduced as a negative developer, it was used alone, with sulphite only or with sulphite and potassium or sodium carbonates. Today, however, it is universally used in combination with hydroquinone (replacing the familiar M-Q combination) for plates, films, and papers, so that there is little need to republish the early formulas. I therefore give only a few typical formulas for paramidophenol combined with hydroquinone.

Kodelon-Q for Papers For Velox, Azo, and bromide papers as used in commercial work, the following formula is advised. Dissolve the chemicals in the order here given: Water, 32 ounces;

Kodelon, 25 grains; hydrochinon, 90 grains; sodium sulphite (E.K.), 330 grains; sodium carbonate, 2¼ ounces; potassium bromide, 4 grains. For Artura Iris, Azo, and development papers used in professional work (portraiture) the formula is slightly modified, as follows: Water, 40 ounces; Kodelon, 10 grains; hydrochinon, 40 grains; sodium sulphite (E.K.), 180 grains; sodium carbonate (E.K.), 180 grains; potassium bromide (saturated solution), 1 drop to each 2 ounces of working developer in use.

Gennert Formula for General Use

The formula advised by Gennert for general use is very similar to the first Kodelon formula given above, viz.: Water, 32 ounces; paramidophenol-hydrochloride (G.G.), 24 grains; hydrokinone (G.G.), 96 grains; sodium sulphite (P.P.G.G.), ⅔ ounce; sodium carbonate (P.P.G.G.), 2¼ ounces; potassium bromide, 5 grains.

For "Soft" Papers

For "soft effect" development papers it is modified as follows: Water, 48 ounces; paramidophenol (G.G.), 11 grains; hydrokinone (G.G.), 55 grains; sodium sulphite (P.P.G.G.), ¾ ounce; sodium carbonate (P.P.G.G.), 1 ounce; potassium bromide, 2½ grains.

Tank Developer

For tank development Gennert advises a combination of paramidophenol, hydroquinone, and pyro, as follows: Dissolve in the order here given: Water, 1 gallon; paramidophenol-hydrochloride (G.G.), 22 grains; hydrokinone (G.G.), 32 grains; sodium sulphite (P.P.G.G.), 1½ ounces; sodium carbonate (P.P.G.G.), 1¼ ounces; sodium bisulphite, 36 grains; pyro, 36 grains; potassium bromide, 6 grains. Develop for 20 minutes at a temperature of 65° Fahr.

Wallace S.M.C. Formula

As a standard formula for development papers Mr. L. H. Wallace, of the Special Materials Company, advises the following: Water, 40 ounces; paramidophenol (S.M.C. para-hydrochlor. or sulphate), 20 grains; hydroquinone, 80 grains; sodium sulphite, 1 ounce; sodium carbonate, 1 ounce; potassium bromide, not to exceed 2 grains or its equivalent in solution. Use less if possible—just

sufficient to keep the whites and shadows clear. To *increase the speed* of the development decrease the sulphite by one-quarter and increase the carbonate by the same amount. For slow development, with soft effects, increase the volume of water, increase the proportion of sulphite and decrease the proportion of carbonate. For plates and films this developer may be diluted: e.g. add 1 ounce of water to each 2 ounces of developer in use. Speed up as required with sodium hydrate as advised on an earlier page.

Emergol

The distributors of this product do not divulge its identity, but their description of it and its formulas for use are identical with those given by Andresen for paramidophenol-hydrochloride. Thus, for a single solution developer: Dissolve 6 ounces potassium metabisulphite in 20 ounces of water and add 2 ounces Emergol. To this mixture is added, with constant stirring, sufficient of a saturated solution of caustic soda to dissolve the paramidophenol base precipitated by the first admixture. This gives a concentrated developer. For use dilute 1 part in 20 parts of water and use without potassium bromide. For developing papers the following is suggested: Water, 40 ounces; Emergol, 20 grains; sodium sulphite (dry), 1 ounce; hydrokinone, 70 grains; sodium carbonate (dry), 3/4 ounce; potassium metabisulphite, 10 grains; potassium bromide (saturated solution), 1 drop to each 2 ounces of developer in use. "A good all around formula for positive prints on paper and motion picture film" is as follows: Water, 1 gallon; Emergol, 50 grains; sodium metabisulphite, 22 grains; sodium sulphite (dry), 1 1/2 ounces; hydrokinone, 120 grains; sodium carbonate (dry); 2 ounces; potassium bromide, 1/2 grain.

Tests for Metol

As the majority of the substitutes for metol in the market are paramidophenol in one form or another, or mechanical mixtures of questionable composition, a few simple tests may be useful. I have already given the commonly used test for the purity of paramidophenol (page 434). For the following simple tests for metol I am indebted to Mr. L. H. Wallace.

Alcohol Test

First: Metol is insoluble in alcohol. Paramidophenol-hydrochloride and hydroquinone are both completely soluble in alcohol. Inasmuch as metol substitutes are frequently cheapened, and their developing power lessened, by the addition of one or both of these, this test for the purity of metol may be profitable. A weighed sample of "metol" is well shaken in ten parts of alcohol, the residue caught on a filter paper and weighed again when dry. Any loss of weight shows adulteration. Any chemical sold as metol which is soluble in alcohol may be condemned at once.

Bichromate Test

The bichromate of ammonia test is not so simple but is of the highest value, especially in making comparative tests with a known sample of pure metol. First prepare a 10 per cent solution of ammonium bichromate, and a solution of 10 grains to each ounce of water of each sample of metol to be tested. Now take a sheet of clean white blotting paper, such as World Photo Finish, and pour about half a dram of each solution to be tested on different parts of the blotter. Then drop *one drop* of the bichromate solution (by the aid of a medicine dropper) on each wet surface. With *pure* metol solution, a dark, purple-black ring will form at once, with a yellow-colored center, requiring several minutes for the yellow color to darken by oxidation. With impure metol or substitute, the center of the ring will immediately turn dark and the edges will not be clearly defined.

Paramidophenol: Phenolate Compounds

Mention has already been made of the property possessed by paramidophenol of acting as an acid with strong alkalies. Andresen observes that by replacing the hydrogen atom of the OH group—see figure 12, page 423—by an alkali metal such as sodium, a phenolate compound results, e.g. of the composition $C_6H_4ONaNH_2$, which we may call sodium paramidophenolate. In practice this sort of compound is formed when a solution of caustic soda is added to a solution of paramido-phenol-hydrochloride.

Unal, Citol, Rodinal, Paranol

Advantage is taken of this to use paramidophenol-hydrochloride as the basis for the preparation of highly concentrated developers of great efficiency, which simply require dilution with water to be ready for use. Such developers, containing phenolate compounds, are Rodinal, Citol, Paraminol, Paranol and (?) Azol. All these are concentrated solutions for dilution with water; Rodinal was also sold as Unal in the form of crystals, the entire contents of the package being dissolved in a given volume of water. They are all patented mixtures, but a developer similar to Rodinal may be prepared as follows:

Formula

In 20 ounces of water dissolve 6 ounces of potassium metabisulphite and then add 2 ounces of paramidophenol hydrochloride. To this mixture add, with constant stirring, sufficient of a saturated solution of caustic soda until the paramidophenol base first precipitated is again dissolved. This concentrated solution should be stored in small bottles, completely filled.

Dilution For Use

In use this concentrated developer, like Rodinal, Paranol, Citol, is diluted with water and restrained, when needed, with potassium bromide (10 per cent solution) according to the sort of negative desired, or the exposure given, or modified to suit the character of the plates, films, or papers in use at the time. In negative development, diluted with from 10 to 20 times its bulk of water, Rodinal (as typical) develops quickly and gives strong contrasts. When further diluted (1:30 or 1:40) development proceeds more slowly and softer contrasts result. Thus for normal exposure use 1 part Rodinal (or other) to 20 parts of water; for over-exposure, take 1 part Rodinal to 10 to 20 parts of water, adding potassium bromide as indicated. For under-exposure, take Rodinal 1 part to 20 to 40 parts of water. For development and bromide papers the dilution should be as 1 to 30, 40 or 50 as the character of the paper may require, with 2 drops of a 10 per cent solution of potassium bromide to each ounce of developing solution. The possibilities of modification are endless.

Metol

Now we approach the crux of the "new" developer problem. It is generally conceded that the universally successful developer—to be produced in America—must either be identical with German metol, or so closely approximating it, in characteristics and performance, that no one will care to ask wherein it differs in one way or another. Many and laborious have been the attempts made in these last few years to produce such a developer—and the end is not yet.

Not Yet "Made in America"

So far as I know, no pure metol, or precise reproduction of German metol, has thus far been produced in America, even in laboratory work. Our American chemists are making splendid strides towards the production of metol equal to the German standard product, and are now very close in working results, though they have not reached clearly defined chemical formulas. It should be remembered that metol, using the word in its proper sense, is incapable of exact analysis, being a patented compound, the commercial manufacture of which has remained a trade secret since its first introduction by Hauff and Andresen, over twenty-five years ago. Moreover, the patents granted to its originators contain no information whatever as to its manufacture, but merely cover its use as developer.

Monomethyl-paramidophenol-sulphate

The developing properties of metol were first observed by Bogisch, but its commercial introduction was due to Hauff (1891), who then described it as the sulphuric acid salt of methylparamido-metacresol, a di-methyl product, having the formula $C_6H_3NHCH_3CH_3OH\,\frac{H_2SO_4}{2}$. In later years cresol was apparently abandoned as a base in favor of phenol, and Hauff stated his product to be monomethyl-paramidophenol-sulphate, with the formula $C_6H_4OHNHCH_3\,\frac{H_2SO_4}{2}$.

What It Is: How Made.

Andresen, who introduced it shortly after Hauff, gives his product the same chemical formula, and tells us that it is derived from paramidophenol by the substitution of

one hydrogen atom of the amido (NH_2) group by a methyl (CH_3) group, and is supplied commercially as a sulphate salt. From this it would seem to be a simple matter to make metol by taking paramidophenol, "methylating" it by the introduction of the methyl (CH_3) group by any of the several chemical methods, and then sulphonating it. But in fact the process is not as simple as it seems, and the resulting methylated-paramidophenol-sulphate is not metol. Paul, stating that metol cannot be made by direct methylation, suggests an indirect method, viz., by heating para-hydroglycine (of which the developer glycin is the hydrochloric salt) up to its melting point (247°C.), when it decomposes into carbonic acid and metol (base) which, after sulphonation, yields the metol of commerce.

Metol—Johnson's Be this as it may, the only actual reproduction of German metol which has as yet appeared is the product introduced by Johnson and Sons, London, in August, 1917, as a "British-made, pure metol (monomethyl-paramidophenol-sulphate). This, it is claimed, is absolutely identical with German metol in chemical composition, constitution, and behavior. It is now obtainable, in limited quantities, in this country. In everyday practical tests it is indistinguishable from German metol, although in appearance it is not as white, and oxidizes more readily than the German product.

Inasmuch as the makers of Metol–Johnsons advise the use of their product in exactly the same proportions as are given in all standard and published metol formulas, where it is used alone, or in combination with hydroquinone or pyro, for plates, films, bromide and development papers, it is unnecessary to publish any specific formulas here.

Swiss Metol With this exception, we have had occasional supplies of a developer said to be "veritable metol" and not a substitute, imported from Switzerland during the past year or two. This was sold here as "Swiss Metol" and as Monomethyl-Paramidophenol-Sulphate, "guaranteed to be the same chemically as the best German metol." It had the appearance of German metol and

gave results precisely similar in practical use. It was said to be of geniune Swiss manufacture, probably from a German-made intermediate.

Elon This developer was introduced by the Eastman Kodak Company some time ago, for use with hydroquinone in a combination said to exactly duplicate the well-known M-Q or Eastman Metol-Quinol developer. Elon is not at present on the market, but the combination referred to, advertised as Tozol, is still obtainable.

Satrapol: Rhodol These two pre-war developers, said to be identical with metol, the first made by Schering and the second by Mallinckrodt, are no longer obtainable.

Monomet Very interesting, but difficult to place, is the British product Monomet, introduced early in 1916 and controlled in America by the Ansco Company. On the other side it is widely used as a universal developer for plates, films, lantern slides, bromide and development papers. In this country it seems to be used chiefly in combination with hydroquinone as a developer for development papers such as Cyko. In practical use for two years it has proved an altogether satisfactory and efficient substitute for German metol.

What Is It? Of the chemical composition of Monomet its makers tell us nothing more than that it is a derivative of cresol—as was the first German metol according to Hauff; and in concentrated solutions with sulphite and alkaline carbonate it throws down a precipitate of amido-cresol base. Its makers advertise it as a "British form of metol" having the following characteristics: (1) "Monomet will go very much further, in regard to the number of prints it will develop, than metol. (2) Monomet is not quite as soluble, in combination with sodium sulphite, as metol," upon which they base the claim that it is 25 per cent purer (as a chemical product) than German metol.

According to the report of the Ansco Research Laboratory, based upon exhaustive analysis and comparisons, it is not identical with German metol, "for

metol in an acid solution, when treated with a nitrite, gives the nitrous methyl-paramidophenol-sulphate, whereas Monomet does not."

Characteristics in Use In appearance Monomet is a grayish powder, keeping well in dry form and in solution. It can be used alone, or in combination with hydrokinone, or for plates, with pyro. It gives greater density in a given time, and is more susceptible to potassium bromide than metol. In ordinary use it does not attack or injure the skin, and it gives a rich, carbon-black image as distinguished from the bluish black given by metol. According to its makers, Monomet can be used as an exact equivalent, weight for weight, for metol in any formula calling for metol, but the caution is given that the proportion of Monomet must not exceed 1½ grains per ounce of water. Note this caution.

Formulas With the last sentence in mind, it may seem superfluous to give any special formulas for the use of Monomet, but the following British formula for a stock M-Q developer for general amateur use may be interesting: Water, 1 British gallon (160 ounces); Monomet, 240 grains; hydroquinone, 475 grains; sodium sulphite (cryst.), 6 ounces; sodium carbonate (cryst.), 8 ounces; potassium bromide, 32 grains. For use dilute with an equal bulk of water. This is said to keep white and clear (stored in yellow or amber bottles) and thoroughly efficient for months.

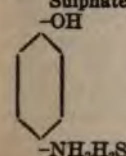
Methylol: Methylated-Paramidophenol-Sulphate The nearest approach to metol made in America seems to be the product introduced as Methylol by the Special Materials Company, of New York. This, as I am reliably informed, is a methylated-paramidophenol-sulphate—which is not metol. The precise chemical formula of Methylol is not yet determined, but is probably about as follows, the (x), here as elsewhere, denominating "an unknown quantity": $C_6H_4OHNH_2(x)H_2SO_4$. The similarity between this and the chemical formula of metol given on page 441 will be noted, together with the absence of the methyl (CH_3) group.

Formulas

A typical formula for development papers is as follows: Water, 32 ounces; Methylol, 15 grains; hydroquinone, 60 grains; sodium sulphite (dry), ¾ ounce; sodium carbonate (dry), 1 ounce; potassium bromide (10 per cent solution), 5 to 10 drops. Use only sufficient potass. brom. to keep the whites clear.

For plates, films, and "soft effect" papers: Water, 32 ounces; Methylol, 10 grains; hydroquinone, 40 grains; sodium sulphite (dry), ½ ounce; sodium carbonate (dry), ½ ounce; potassium bromide, 2 grains. It is recommended that the potass. brom. be first dissolved in an ounce of the water and added to the developer after the other ingredients have completely dissolved. These formulas are, of course, equally serviceable for use with any reliable make of methylated paramidophenol-sulphate (e.g. Gennert's Paramet).

Paramidophenol-Sulphate



Combined with sulphuric acid, paramidophenol (base) gives us paramidophenol-sulphate, a developer introduced by many American and British firms as replacing metol. An average sample contains over 67 per cent paramidophenol, but some brands claim a much higher percentage. It is sold under its proper name as paramidophenol-sulphate, and under many trade names, as Kathol, Fredol, Duital, Mitus (?), Serchol, etc.

Conflicting Claims

Strangely conflicting claims are made for paramidophenol-sulphate as a developer compared with other phenol derivatives. Some makers claim that it is preferable to paramidophenol-hydrochloride, others that it is superior to metol in developing power, while, on the other hand, there are those who say that it is not equal to either in keeping quality, speed of development and capacity for repeated use up to exhaustion.

A Possible Explanation

It may be that the conflict arises from a misunderstanding. Paramidophenol-sulphate used with the alkaline carbonates is undoubtedly "slower" than metol, and, in this respect the chloride salt is perhaps preferable.

Also, paramidophenol-sulphate precipitates paramidophenol (base) in sodium sulphite and carbonate solutions, which robs the solution of developing power and so "slows up" its action. This is clearly seen in the repeated or long-continued use of such a developer. But by the addition of a small amount of sodium hydrate (caustic soda) the "speed" of the developer can be readily brought up to the metol standard, and by the occasional further addition of sodium hydrate in small amounts, this speed and developing power can be so completely maintained that, with this modification, paramidophenol-sulphate will develop as rapidly and go as far as metol, and probably farther than paramidophenol-hydrochloride. This point was given special emphasis in the literature introducing Kathol—a paramidophenol-sulphate developer of the best sort. Photographers, however, cling to an old-time prejudice against the use of caustic alkalies, and prejudice—is prejudice! It is now known that the peculiar advantages sought to be gained by the use of caustic soda with paramidophenol-sulphate are equally well secured by methylating the paramidophenol during its manufacture, so that the use of caustic soda can be eliminated and an energetic, speedy, and lasting developer made up with alkaline carbonates. For which reason it is probable that paramidophenol-sulphate will soon be generally replaced (commercially) by methylated paramidophenol-sulphate.

Characteristics in Use

In use paramidophenol-sulphate is invariably combined with hydroquinone, whether for plates, films, or papers. It is a clean, rapid-working developer, giving detail quickly and building up density more slowly. With some brands the use of sodium hydrate is suggested as a means of controlling the speed of or reënergizing the developing solution when it seems to "slow down," but other makes claim that "no caustic soda is required" in their use. In the latter case one may surmise that they are either "methylated" products, or the hydrochloride salt in disguise, or simply high-grade paramidophenol-sulphate with its characteristic virtues and shortcomings. Given a well-balanced formula and

normal exposure, paramidophenol-sulphate yields negatives of good gradation, clear in the whites and without veil in the shadows, and of a rich, black color. It is very susceptible to the restraining power of potassium bromide, which should be used with caution and rarely in excess of 1 grain potass. brom. to each 7 to 10 grains of developer. This caution is especially to be noted where paramidophenol-sulphate is used to replace metol (in equivalent amounts) in any metol formula.

Duital Typical formulas for some of the many brands of paramidophenol-sulphate are as follows: Duital for development papers, plates, and films—Water, 16 ounces; Duital, 15 grains; hydroquinone, 48 grains; sodium sulphite (dry), ⅓ ounce; sodium carbonate (dry), 1⅛ ounces; potassium bromide, 2 grains or more, as required. For plates and films add 1 ounce of water to each 2 ounces of the above. For tank development: Water, 1 gallon; Duital, 90 grains; hydroquinone, 360 grains; sodium sulphite (dry), 3 ounces; sodium carbonate (dry), 9 ounces; potassium carbonate, 15 grains. Develop 20 minutes at 65° Fahr.

Fredol The standard developer for Rexo and other development papers is: Water, 40 ounces; Fredol, 20 grains; hydroquinone, 60 grains; sodium sulphite (dry), ¾ ounce; sodium carbonate (dry), 1 ounce; potassium bromide, 12 grains. For plates and films dilute the quantity used with an equal volume of water.

Kathol This developer has recently been modified for use without sodium hydrate. A typical formula for plates, films, and "soft effect" papers is: Water, 40 ounces; Kathol, 10 grains; hydroquinone, 40 grains; sodium sulphite (dry), 1 ounce; sodium carbonate (dry), ¾ ounce; potassium bromide, 3 grains (previously dissolved in a little water and added in solution). A formula for development papers, generally, is: Water, 32 ounces; Kathol, 20 grains; hydroquinone, 60 grains; sodium sulphite (dry), 1 ounce; sodium carbonate (dry), 1 ounce; potassium bromide, 2 grains (added as directed in the second methylol formula).

Mitus This is said to be "95 per cent pure paramidophenol-sulphate," nevertheless the following formula (without caustic soda) is advised for tank development: Water, 1 gallon; Mitus, ½ ounce; hydroquinone, ¾ ounce; sodium sulphite, 5 ounces; sodium carbonate, 3 ounces; potassium metabisulphite, 80 grains; potassium bromide, 25 grains. Add water to make the bulk of the solution up to 5 gallons. Develop 20 minutes at 65° Fahr. For development papers use the second Kathol formula above, but substitute an equal amount of Mitus for the Kathol specified in that formula.

Serchol This is a British product which is probably paramidophenol-sulphate or the hydrochloride salt of high grade. It can be used with hydroquinone for development papers; with pyro for plates and films; or alone as a single-solution developer for plates or papers. Typical formulas are as follows: For bromide and gaslight papers, and lantern slides: Water, 20 ounces; Serchol, 6 grains; hydroquinone, 18 grains; sodium sulphite (cryst.), 120 grains; sodium carbonate, 120 grains; potassium bromide, 1 grain. For tank development, 20 minutes at 65° Fahr: Water, 36 ounces; Serchol, 6 grains; hydroquinone, 18 grains; sodium sulphite (cryst.), 1½ ounces; sodium carbonate (cryst.), 120 grains; potassium bromide (10 per cent solution), 10 drops. The Serchol-Pyro formula is said to be especially advantageous for cases of known under-exposure. Make up two solutions, as follows: No. 1—Water, 20 ounces; Serchol, 40 grains; pyro, 48 grains; potassium metabisulphite, 100 grains. No. 2—Water, 20 ounces; sodium carbonate (cryst,). 2 ounces; potassium bromide, 10 grains. For use take equal parts, increasing the proportion of No. 2 where under-exposure is known or indicated.

Tonall Tonall is a developer of American manufacture offered as "the most perfect equivalent for metol on the market." The chemical name is given as mono-methyl-paramidophenol-chloride, which must be a printer's blunder! It is said to keep well in solution, is suitable

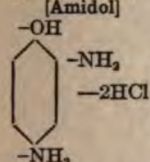
for tank development, films and papers, and to be much more energetic than most metol substitutes.

Whartol This is an American product of unknown composition but said to possess "the forcing power of metol, is easier to control and does not fog as quickly." It is used in equivalent amount to replace metol in any metol formula, with the caution that Whartol needs only one-third the amount of potassium bromide generally used with metol. These claims indicate that it is either paramidophenol-hydrochloride or paramidophenol-sulphate—plain or methylated.

Tarcole A developer of the same general class as the above, i.e. either the sulphate or hydrochloride form of paramidophenol, is offered by a Cleveland, Ohio, firm as possessing good qualities. It is an American product and is said to be equally suitable for all classes of photographic work. I have not had an opportunity to test its working qualities, and the only announcement of it which has appeared tells nothing of its chemical composition or of formulas for use.

Scalol Under this name Johnson & Sons, a few years ago, introduced a developer intended to replace metol, used in combination with hydroquinone or pyro. Its chemical composition was not divulged, but from its characteristic behavior and results it was probably either the hydrochloride or sulphate salt of paramidophenol. It would seem to have been superseded by the same makers' Metol-Johnsons.

Diamidophenol-hydrochloride [Amidol]



By replacing two hydrogen (H) atoms in the *ortho* and *para* positions in phenol (Fig. 5, page 420) by two amido (NH_2) groups, Hauff, in 1892, obtained diamidophenol, the hydrochloride salt of which, $C_6H_3OH(NH_2)_2$—$2HCl$, was later introduced commercially by Hauff and Andresen under the trade name Amidol. Dianol (Lumière), Nerol (Schering), Amidol-Johnson, and Acrol (Eastman) are chemically identical products. It is

also sold under its proper name, e.g. Diamidophenol (Eastman; Gennert; S.M.C; etc.). It is now made in America and Britain, the German brands being no longer available. The original German Amidol is a steel-blue, needle-like crystal, which remains clear and colorless in solution, but is liable to lose its developing power after a time. The American product is of a yellow color and comes in larger crystals. Its quality is excellent, but it oxidizes more readily than the European brands, with visible coloration, an advantage as visibly showing the deterioration of the solution.

Characteristics Diamidophenol is readily soluble in water, and somewhat sensitive to temperature. The working solution should be kept between 60° and 65° Fahr. When added in small quantities, potassium bromide acts with Amidol only as a clearer, fairly large amounts being needed to act as a restrainer.

In Use Under whatever name, diamidophenol-hydrochloride possesses remarkable properties as a developer, and deserves a wider appreciation for general use than it has thus far received. Its chief characteristic is its power as an active developer in combination with sodium sulphite alone, without the addition of alkalies. It is acknowledged to be without an equal as a developer for bromide paper, working rapidly, without fog or stain, and giving prints of fine gradation, with a rich, velvety, bluish black color. Because of its clean working properties and the fine grain it yields, it is excellent for lantern-slide work and should be equally serviceable for motion-picture positives. It can also be made to give very pleasing results in negative and film development. It is important that the sodium sulphite used in making up an amidol developer should be perfectly fresh and not stale or oxidized, whether in solution or solid. The developing solution can be used repeatedly as long as it does not show coloration or other sign of loss of power by oxidation. As the density or color given by amidol is slightly lost in the fixing bath, development should be carried a little further than the tone or density desired, which applies to prints and plates.

Formulas For the reasons already given, it is preferable to make up amidol developers only in the quantity required for a day's use. Typical formulas are as follows: For plates and films.—Water, 10 ounces; sodium sulphite (cryst.), 1 ounce, or dry, ½ ounce; diamidophenol (Amidol, etc.), 40 grains. Restrain with potassium bromide (10 per cent solution) as needed. Underexposure can be helped by the addition of 10 per cent sodium sulphite solution as indicated.

For bromide papers: Water, 20 ounces; sodium sulphite (dry), 320 grains; potassium metabisulphite, 120 grains; diamidophenol (Amidol, etc.), 60 grains; potassium bromide, 5 grains. (Dilute for gray tones). For lantern-slide plates: Water, 10 ounces; sodium sulphite (dry), 150 grains; diamidophenol, 50 grains; potassium bromide, 3 grains.

For tank development with Dianol: Water, 60 ounces; sodium sulphite (dry), 180 grains; potassium bromide (10 per cent solution), ½ ounce; Dianol, 45 grains. Develop 30 minutes at 65° Fahr.

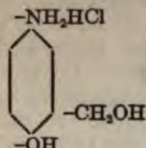
Duratol This developer, said to be benzyl-paramidophenol, was introduced by Schering as a universal developer, to be used in combination with hydroquinone. It won great favor upon its first introduction (1911–12) but is no longer obtainable.

Duratol is a soft-working developer of the metol class, especially suitable for instantaneous work. It is stable in solution, free from tendency to fog or stain, does not injure the hands, and has unusual developing power, i.e. it is not quickly exhausted, in which it surpasses other derivatives of paramidophenol.

A typical formula is: Hot water, 32 ounces; Duratol, 15 grains; sodium sulphite (dry), 1 ounce; sodium carbonate (dry), 1½ ounces; hydroquinone, 75 grains.

Duratol-solution was a concentrated form of this developer, requiring only dilution with water to be ready for use. For normal exposure, it was diluted with 16 parts of water; for underexposure, with 30 to 40 parts; for overexposure, with 8 to 10 parts of water, and the addition of potass. bromide.

Edinol

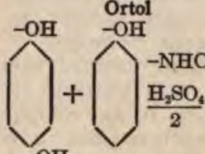


This developer was first introduced (as Paramol) by the Bayer Co. in 1901, as the outcome of a new method for the preparation of oxyalcohols of the aromatic series, worked out by Eichengrün in 1899. The formation of the compound, as briefly explained by Schweitzer before the American Chemical Society in 1903, is too complex for publication here. Suffice it to say, therefore, that edinol is the hydrochloride salt of meta-amido-ortho-oxy-benzy-alcohol, known to the chemist by the formula $C_6H_3OHCH_2OHNH_2HCl$.

Characteristics

As a developer it stands between the slow type, such as pyro, hydroquinone, and the rapid types such as metol, rodinal, amidol, with properties peculiar to itself. It comes in the form of a yellowish crystalline mass. On account of its great solubility it permits the preparation of concentrated stock solutions. In use it is free from fog and staining tendencies and it is non-poisonous, i.e. does not attack the fingers. It is a clear working developer, permits the use of large amounts of potassium bromide without noticeably affecting the contrasts of the image, and is an excellent developer for plates and films, but especially desirable for lantern slides and bromide papers and can be used repeatedly. It is used alone with alkaline carbonates, or in combination with hydroquinone or adurol. At present edinol is not obtainable in this country, but edinol-hydroquinone in powder form, ready for use by simply dissolving in a given quantity of water, is still available. This stock solution is diluted (like Rodinal) according to use.

Ortol



By a molecular combination of hydroquinone with methyl - ortho - amidophenol (1:2), Hauff in 1896 obtained a very useful developer with distinctive properties, which he introduced under the trade name Ortol. Commercially, it is the sulphate of mono-methyl-ortho-amidophenol with hydroquinone, having

the formula $C_6H_4(OH)_2 + C_6H_4OHNHCH_3 - \frac{H_2SO_4}{2}$ Roylon is a similar mixture, used as an equivalent and giving identical results.

Characteristics Ortol comes as a coarse, yellowish, crystalline powder, very soluble in water. As a developer it stands between pyro and the familiar metol-hydroquinone combination. In its dry state it oxidizes readily, but may be kept unchanged for years in well-stoppered, orange-colored bottles. In solution with potassium metabisulphite it retains its power and keeps well, colorless, for many months. It gains in developing power in combination with alkaline sulphites and sodium carbonate, and is very sensitive to the retarding action of potassium bromide, which makes it readily controllable for plates which have been overexposed. It has no injurious action on the hands, and gives a brown-black image of fine grain. It can be used as a universal developer, by modification, for plates, films and papers or for lantern slides, and can be combined with hydroquinone.

Formulas A favorite two-solution developer for plates or films is: No. 1—Water, 20 ounces; potass. metabisulphite, 50 grains; ortol, 100 grains. No. 2—Water, 20 ounces; sodium carbonate (cryst.), 2 ounces; sodium sulphite (cryst.), 2 ounces. For use, take equal parts Nos. 1 and 2 and water, with 2 to 5 drops of a 10 per cent solution of potass. bromide for each ounce of mixed developer.

Single Solution A good single solution developer for plates or films is: Water, 8 to 12 ounces (according to subject and exposure); ortol, 12 grains; potass. metabisulphite, 6 grains; sodium sulphite (cryst.), 120 grains; potass. carbonate (cryst.), 50 grains; potass. ferrocyanide (cryst.), 20 grains. Potassium bromide is not needed with this formula, the ferrocyanide retarding development slightly, giving clearness and vigor.

Tank Development For tank development (plates) where widely different exposures have to be dealt with, take: Water, 20 ounces; potass. metabisulphite, 5 grains; ortol, 10 grains;

sodium sulphite (cryst.), 65 grains; sodium carbonate (cryst.), 65 grains. Examine the negatives after 15 minutes and remove as the desired density is reached. Temperature 65° Fahr.

Bromide Papers

For bromide papers, combine with hydroquinone, as follows: Water, 20 ounces; ortol, 15 grains; sodium sulphite (cryst.), 190 grains; hydroquinone, 45 grains; sodium carbonate (cryst.), 160 grains; add a few drops of a saturated solution of potassium bromide, sufficient to keep the whites clear.

Glycin

-OH

$-NH\ CH_2CO_2H$

Glycin is a derivative of paramidophenol, formed by replacing one hydrogen (H) atom in the amido (NH_2) group by the monovalent group CH_2 CO_2H. It was introduced simultaneously by Hauff and Andresen as a developer peculiarly adapted for tank development or for negatives where a very fine, close-grained image is desirable but is not now obtainable. It is known to chemists as para-oxy-phenyl-amido-acetic acid, with the formula $C_6H_4OHNHCH_2CO_2H$.

Preparation-: Characteristics

Glycin is commercially prepared by heating an aqueous, alkaline solution of paramidophenol (base) and chlor-acetic acid in molecular proportion of 2:1. On cooling, this gives a glistening, gray crystalline powder, i.e. glycin, which is insoluble in water, but soluble in sodium sulphite and carbonate solutions, with which it forms a slow but powerful developer, giving fine-grained images of a warm black color. It may be used with hydroquinone or pyro for plates and films, but is generally used alone as a tank developer for plates, lantern slides and reproduction work.

Formula

Miller gives the following formula for tank use: Hot water, 5 ounces; sodium sulphite (dry), 140 grains; sodium carbonate (dry), 140 grains; glycin, 280 grains. This, made up to 8 ounces with water, forms a stock solution. For use take 1 ounce of this to 32 ounces of water. Develop 30 minutes at 50° Fahr.

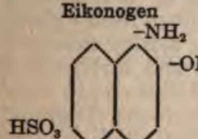
Caution Note that in the use of glycin it is absolutely essential to wash the plates after development before putting them into the fixing bath. Stains will result if this is not done.

Hydramine This is a chemical combination of hydroquinone with para-phenylene-diamine, made by Lumière and sold under the trade name hydramine, but not obtainable in this market. It has the formula $C_6H_4(OH)_2 + C_6H_4(NH_2)_2$. The developing properties of para-phenylene-diamine were made known by Andresen in 1888, the combination with hydroquinone being due, apparently, to Hauff. Commercially, para-phenylenediamine is prepared by adding acetic acid to aniline, which is nitrated in the usual way, giving para-nitro-acetanilid which, after reduction by hydrogen, yields para-phenylenediamine.

Characteristics Hydramine comes in white scales or powder, readily soluble in warm water, and in conjunction with caustic lithia or formosulphite and sodium sulphite, gives a slow-working but energetic developer, which keeps well and does not stain or attack the skin.

Formula A formula given by Lumière is as follows: Water, 20 ounces; sodium sulphite (dry), 144 grains; caustic lithia, 29 grains; when dissolved, add hydramine, 48 grains. Use a few drops of a saturated solution of potass. bromide per ounce of developer as restrainer when its need is indicated by veiling or tendency to fog.

Eikonogen



The developer we know as Eikonogen, or as it is properly spelled, Ikonogen, belongs to a different family from those we have thus far considered, being a naphthalene derivative. Its developing properties were first made known by Meldola, but its commercial introduction was due to Andresen who, in 1889, gave it the name of Eikonogen—known to the chemist as sodium-amido-beta-naphthol-sulphonic acid, with the formula $C_{10}H_5OHNH_2HSO_3$.

Characteristics Eikonogen comes as a mass of semi-opaque, yellowish crystals with a shining luster, sparingly soluble in cold, but readily soluble in boiling water. Used alone, it is a soft-working developer, giving abundant detail and gradually building up density. It is generally used with hydroquinone, is sensitive to the action of potassium bromide, works cleanly without fog, and does not stain the fingers nor injure the skin.

Formula A reliable two solution formula is as follows: No. 1.—Water, 24 ounces; sodium sulphite (dry), 1 ounce; Eikonogen, 120 grains; hydroquinone, 30 grains. No. 2.—Water, 16 ounces; sodium carbonate (dry), 2 ounces. For plates, films, and lanter slides take 3 ounces of No. 1 and 1 ounce No. 2. For bromide and gaslight papers, add 1 or 2 drops of a saturated solution of potass. bromide to each 4 ounces of the developing solution.

Diogen: Imogen: Tylol: Diphenal These, as far as I know, have not been in the market for some years, and may therefore be dismissed with little attention here. Diogen, as seen in Fig. 19, page 424, is closely related to eikonogen. It was introduced by the A.G.F.A. Co. as a whitish powder, forming a concentrated developer with sodium sulphite and potassium carbonate, which was diluted for use. Imogen, also an A.G.F.A. Co. product, comes as a white powder, easily soluble in hot water, giving, with sodium sulphite and sodium carbonate, a fairly quick-working developer, free from fogging or staining tendencies, and somewhat retarded by low temperatures. Tylol is a French product, derived from a phenol base. It comes as a gray powder, readily soluble in water; used with sodium sulphite and carbonate, it forms a rapid developer of the metol class and is, therefore, generally combined with hydroquinone. Diphenal, an A.G.F.A. product, was a concentrated solution developer based on diamido-oxydiphenyl (see Figs. 20 and 21, page 424). It was peculiarly suited for the development of overexposures, being free from fogging tendencies, and in use was diluted with from 15 to 25 parts of water according to subject and exposure.

Drawing to the End

We have now reached the end of this brief survey of the photographic developers available or in use today. Some of them might have been dealt with at great length with profit, but my space did not permit of this. Two or three American-made developers have been intentionally passed over without mention, simply because their makers persistently ignored my requests for information, and I have been unable to obtain the products from dealers. Oblivion best befits such—makers and products.

Hitol

There remain only the mechanical mixtures, or ready-prepared-for-use developers, of which Hitol, Rytol and Kalogen are prominent examples. Of these Hitol only claims special mention, because of its really remarkable lasting power, or capacity for repeated use before exhaustion. This will be referred to in detail in the February issue of THE PHOTO-MINIATURE, which will deal with the modern methods of development — appropriately following this discussion of the developers themselves.

SAMUEL WEIN, B.Sc.

Notes and Comment

The current revivial of interest in home-prepared printing papers has brought me many questions as to the best papers for this use. These questions are all answered in three words, viz.: Use Whatman Papers. A note concerning Whatman Papers is in preparation for the February issue. Meanwhile readers who are seeking absolutely pure, hand-made papers as a basis for the preparation of plain silver, kallitype, platinum or gum bichromate printing papers, should write H. Reeves Angel & Co., 120 Liberty Street, New York City, for the sample book of Whatman Papers, and see for themselves.

Gardens East and West. An exhibition of pictorial photographs of gardens in California, Long Island, Connecticut and Rhode Island, by Frances Benjamin Johnston, was held at the Touchstone Galleries, New York, in December. It comprised about sixty 14 x 17 prints on Japanese tissue, in a warm, black tone, and afforded a noteworthy showing of Miss Johnston's inimitable skill in this field, to which she has devoted herself for some years past.

An exhibition of war photographs by the Royal Flying Corps is being given at the Camera Club, London. The combination of practical photographic work with remarkable examples of aërial landscape, cloud formations and the like, gives this exhibition a unique interest. It is much to be desired that such an exhibition could be given in our American cities, as giving a foretaste of what may be expected from the new Photographic Division of the U. S. Signal Service Corps which has enlisted the services of many notable American photographic workers.

This is the day of standardization. We have learned that, in photography, this way lies progress and success. For which reason it is interesting to note that the new factory of the Central Dry Plate Co., of Benavis, St. Louis, Mo., has been planned, built and equipped with this single aim, viz: the production of a definite and standardized product. It means success—for the makers as well as the users of Central dry plates.

The new factory comprises a group of buildings covering about nine acres, on the very site formerly occupied by the M. A. Seed Dry Plate Co. at Woodland (renamed Benavis). It has been designed and equipped exclusively for the manufacture of a complete line of dry plates, for general and special photographic uses, particular stress being placed on the provision of a research laboratory which will keep the Central products abreast of every scientific and practical advance in the production of perfect plates and color filters for all processes. The Central Dry Plate Co. is now headed by Mr. F. Ernest Cramer, with a large crops of skilled workers, including Mr. R. James Wallace. The combination of a group of such men and a manufacturing plant of the sort indicated promises an interesting evolution in American photography, and I hope to keep the readers of The Photo-Miniature informed of the activities of the organization.

Underwood & Underwood, of New York, long famous as the world's largest manufacturers of stereoscopic views and news pictures for publication, have incorporated their activities in an $8,000,000 company, and plan to establish a chain of branches throughout the country to follow the wide developments in commercial photography.

An illustrated paper explaining the Unit System of Photography by its author, F. M. Steadman, appears in the December issue of "Photo-Era" (Boston, 20 cents). Those who are curious as to the working and efficiency of this system will do well to see this issue of the "Photo-

Era," which also offers an extremely interesting article by J. W. Kilmer on "Photography in Colors—The Visual Index."

A supply of platinotype (sepia), palliadotype and satista papers has been received by Willis & Clements, of Philadelphia, and those who favor these beautiful papers should lose no time in acquiring sufficient for their needs.

Pleasing brown tones on gaslight papers by simple development are said to be obtainable by the use of pyrocatechin and sodium carbonate. The method and formula advised are published in the December issue of "The Camera" (Philadelphia, 15 cents).

The taking, projecting and printing of "movie" portraits on glass plate, by the system invented by Lieutenant G. Bettini, was practically demonstrated at the Hero Land Bazaar recently held in New York. This system, which is intended for studio or home use, gives hundreds of small portraits on a glass plate about 5x8 inches, any one of which images may be enlarged at will.

About Lenses. This is a booklet of 26 pages, published by the Eastman Kodak Company, Rochester, N. Y., for free distribution, and is intended to give, in clear and simple language, such information about lenses as will enable the inexperienced to select such a lens as is best fitted for the particular requirements of individual use. It does just that and is well worth sending for. The text is unusually clear and direct in its information and some twenty-four diagrams materially add to the value of the brochure.

Pictorial Photographers of America

The Pictorial Photographers of America have completed their first year of activity as a formal organization. On Monday evening November 5, 1917, the annual election of officers was held at the National Arts Club, New York City. Past work was reviewed and work to be done in the future was discussed.

The principal achievement of the P. P. of A. has been the launching of two traveling exhibitions of the work of members, each group numbering more than one hundred prints. The "tour" began in Minneapolis in September, 1917, and the last showing will be in New Orleans in May 1918. The complete schedule for the two groups follows:

Western Group of Prints. Minneapolis Institute of Arts, September, 1917; Milwaukee Art Institute, October; Art Institute of Chicago, November; City Art Museum, St. Louis, December; Toledo Museum of Art, January, 1918; Detroit Museum of Art, February; Cleveland Art Museum, March; Cincinnati Museum of Art, April.

Eastern Group of Prints. Newark Museum Association, October, 1917; New Britain Institute, Conn., November; Worcester Art Museum, December; Syracuse Museum of Fine Arts, January, 1918; Guild of Allied Arts, Buffalo, February; Grand Rapids Art Association, March; University of Oklahoma, April; New Orleans Art Association, May.

At the monthly meetings, held on the first Monday evening of each month, from October to May, at the National Arts Club, New York City, lectures and lantern-slide talks are given. Among those who

addressed the members last year were Henry H. Sayler, editor of *The New Country Life;* Robert J. Cole, art critic of the New York *Evening Sun;* Walter G. Wolfe; Major Kendall Banning, of the Photographic Division, U. S. Army, Signal Corps.

Last summer the members were the guests for three days of Clarence H. White, at Canaan, Conn. Picnics, talks, lantern-slide exhibitions, earnest debates on filters, tanks, and lenses, and just plain fun, kept everyone busy, and these summer reunions will be made a permanent feature of the organization's activities.

Following is a list of the officers, and a résumé of the objects of the P. P. of A. Clarence H. White, President; Dr. A. D. Chaffee, Vice-President; Gertrude Kasebier, Hon. Vice-President; Dr. Charles H. Jaeger, Treasurer; Arthur D. Chapman, Corresponding Secretary; Edward R. Dickson, Secretary.

The aims of the P. P. of A. are: (*a*) To stimulate and encourage those engaged and interested in the art of photography.

(*b*) To honor those who have given valued service to the advancement of photography.

(*c*) To form centers for intercourse and for exchange of views.

(*d*) To facilitate the formation of centers where photographs may always be seen and purchased by the public.

(*e*) To enlist the aid of museums and public libraries in adding photographic prints to their departments.

(*f*) To stimulate public taste through exhibitions, lectures, and publications.

(*g*) To invite exhibits of foreign work and encourage participation in exhibitions held in foreign countries.

(*h*) To promote education in this art, so as to raise the standards of photography in the United States of America.

All photographers who are interested in the aims and the work of the Pictorial Photographers of America are welcome at the monthly meetings.—*Pictorial Photographers of America, 119 East 19th Street, New York City.*

Books and Prints

PHOTOGRAPHY IN COLOURS. A textbook for amateurs and students of physics. By George Lindsay Johnson, M.A., M.D. Third edition; 302 pages; with 14 plates (5 in color) and many illustrations in the text. Cloth $2. (Dutton.) For sale by Tennant and Ward, New York.

Within the past few weeks three men have come to me, each claiming, as the result of years of patient experimenting, to have finally solved the problem of photography in colors. One brought direct color transparencies on glass plates, flat, roll and cinematograph films and prints in color on paper. Another brought color prints on paper only, and the third had films for cinematograph projection, having shown me successful color prints on paper two years ago. Since these processes are not yet commercially available, I was asked to say nothing definite about them. At least a dozen such processes are brought forward every year. Some are introduced commercially, others never reach that stage. Of those so introduced, some few enjoy a brief popularity, others fail, or are withdrawn from the market. The perfect process or method has not yet arrived.

Public interest in the problem, however, is as keen today as it was fifty years ago, and the evolution or development of photography in colors forms perhaps the most absorbingly interesting chapter in the history of photography. Something of this development has been set forth in THE PHOTO-MINIATURE, Nos. 38, 81, 128 and 147. The "Color Photography Supplement" issued monthly with "The British Journal of Photography" offers a complete summary of current progress in new and old processes. And there have been three or four books on the subject, all now, I believe, out of print and difficult to find.

These apart, Dr. Johnson's "Photography in Colours," here noticed, is the only textbook on the subject at present available. This is the third edition and, in addition to the matter given in earlier editions, contains a full description of the Raydex process, as well as Gaumont's new method of cinematography in colors and Carrara's method of reproducing Autochromes on paper. A chapter has also been added on Art in Color Photography and a further chapter on Photomicrography in Color.

The author's residence in Johannesburg, South Africa, for a year or two past, doubtless accounts for his failure to mention the most recent developments in color photography in America, e. g. the Hess-Ives Hicro, the Kodachrome, the Kunz and the Warner-Powrie processes. In other respects the book is comprehensive in its treatment of the subject, beginning with an explanation of the nature of light and color and touching every phase of the problem down to the latest methods of photomicrography in color.

Clarence H. White. A few days ago I spent a happy hour with Clarence H. White, at his School of Photography in the old Washington Irving house on East 17th Street, New York City, looking over the work of the students of the School. Judging by the work I saw, the scheme of instruction followed at this School deserves the highest praise. It consists of lectures and practical work under competent instructors, covering the fundamental principles of photography and their application in practical and pictorial work. The albums of prints representing various "problems" worked out by the students unaided by their teachers, were most interesting and demonstrated, in a striking way, the efficiency of the methods of teaching employed.